Operating Experience with Systems

D. Randall Lacey PE
Abigail Krich

CORNELL

Campus Lab Buildings

- 14 M gross sq ft of campus buildings
- 1.3 million net sq ft of wet lab space
- 1400 fume hoods on campus
- Over 50 buildings with fume hoods
- 25 buildings with > 10 fume hoods
- Research income > $400 M /yr

Building Environment

- Design and construction standards in place for 15 years
- Project and construction mgmt by university staff
- Controls installation, TAB and commissioning by in-house trades
- 300 person union trades shop available for maintenance
- Utilities are metered for every building

- Older labs are constant volume reheat
- First full VAV was a retrofit in mid1980s
- 6 different vendors of VAV hood controls
- Two buildings have heat recovery
- Several buildings and retrofits are 2 position

Sample Building Group

- 12 buildings selected
- 2 M square feet total space
- Several mechanical systems included
- Included chemistry, biology, physics, and other disciplines

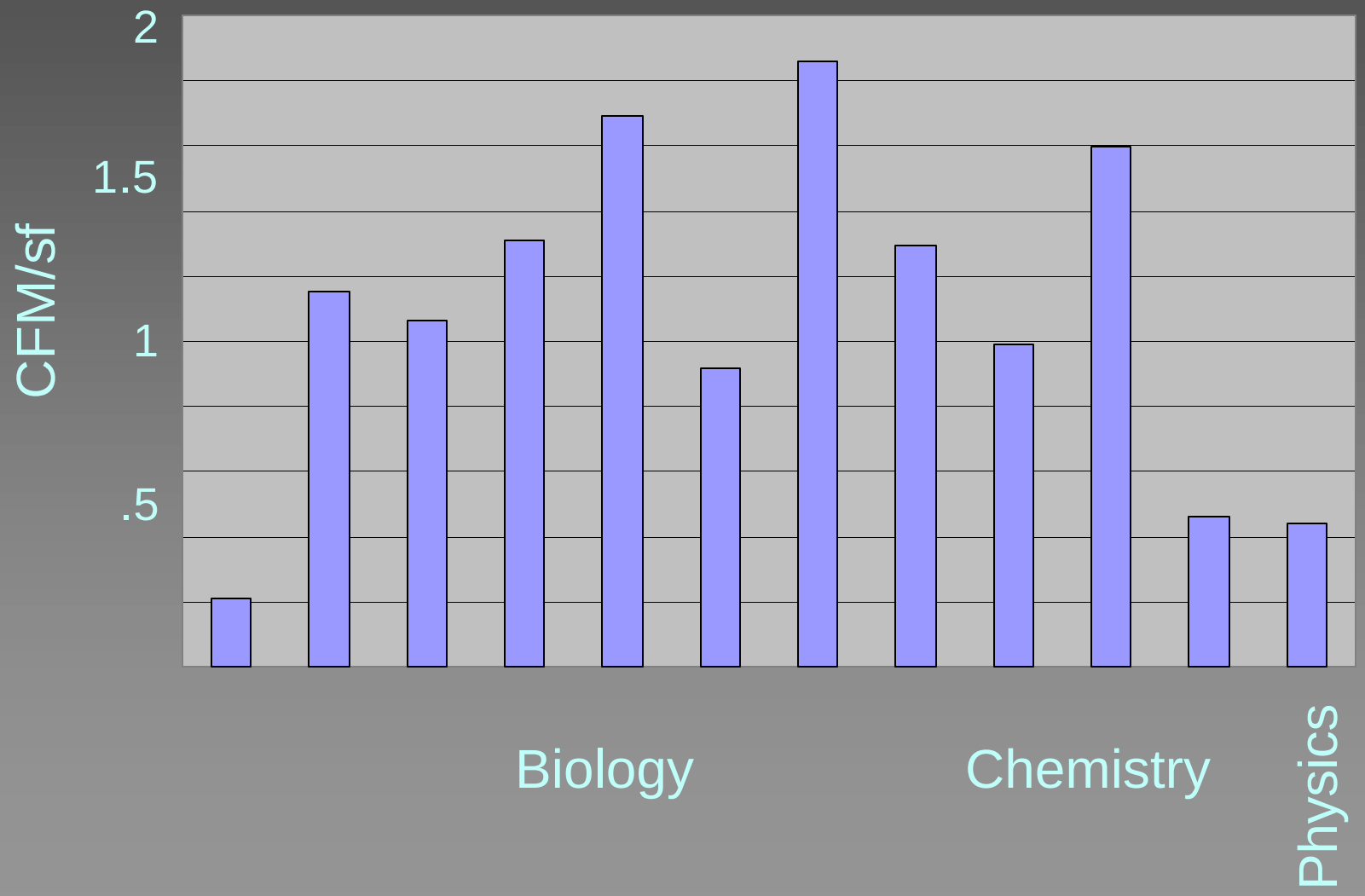
Metrics Used to Evaluate buildings

- Design CFM / Square foot
- BTU / yr / sq ft
- BTU / yr / CFM

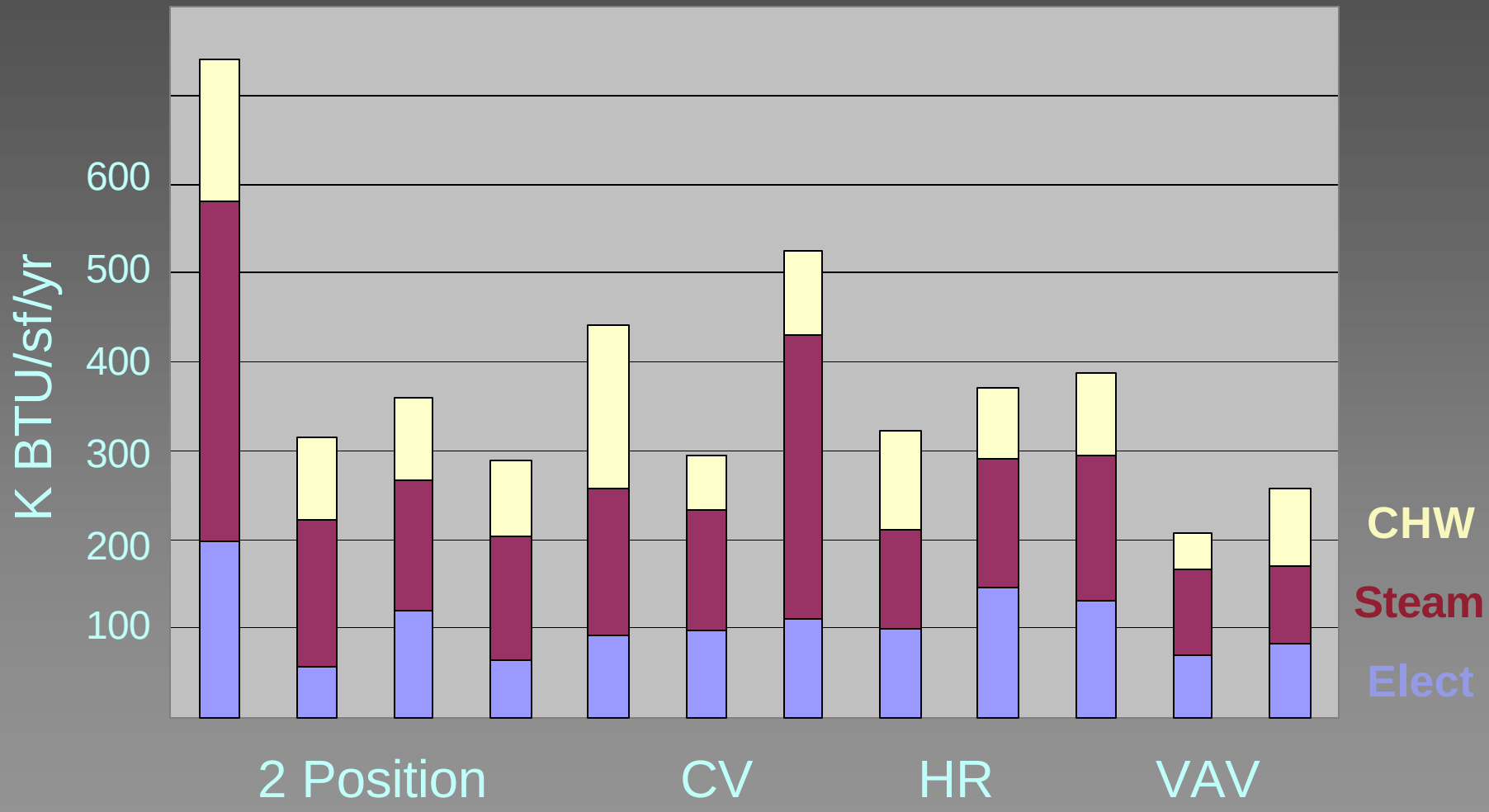
Results of Sample Group

	Range	Average
Air flow rate	.4 – 1.9	1.1 CFM/ft2
Energy Use	210-740	375 kBTU/ft2/yr
Efficiency	135-900	300 kBTU/cfm/yr

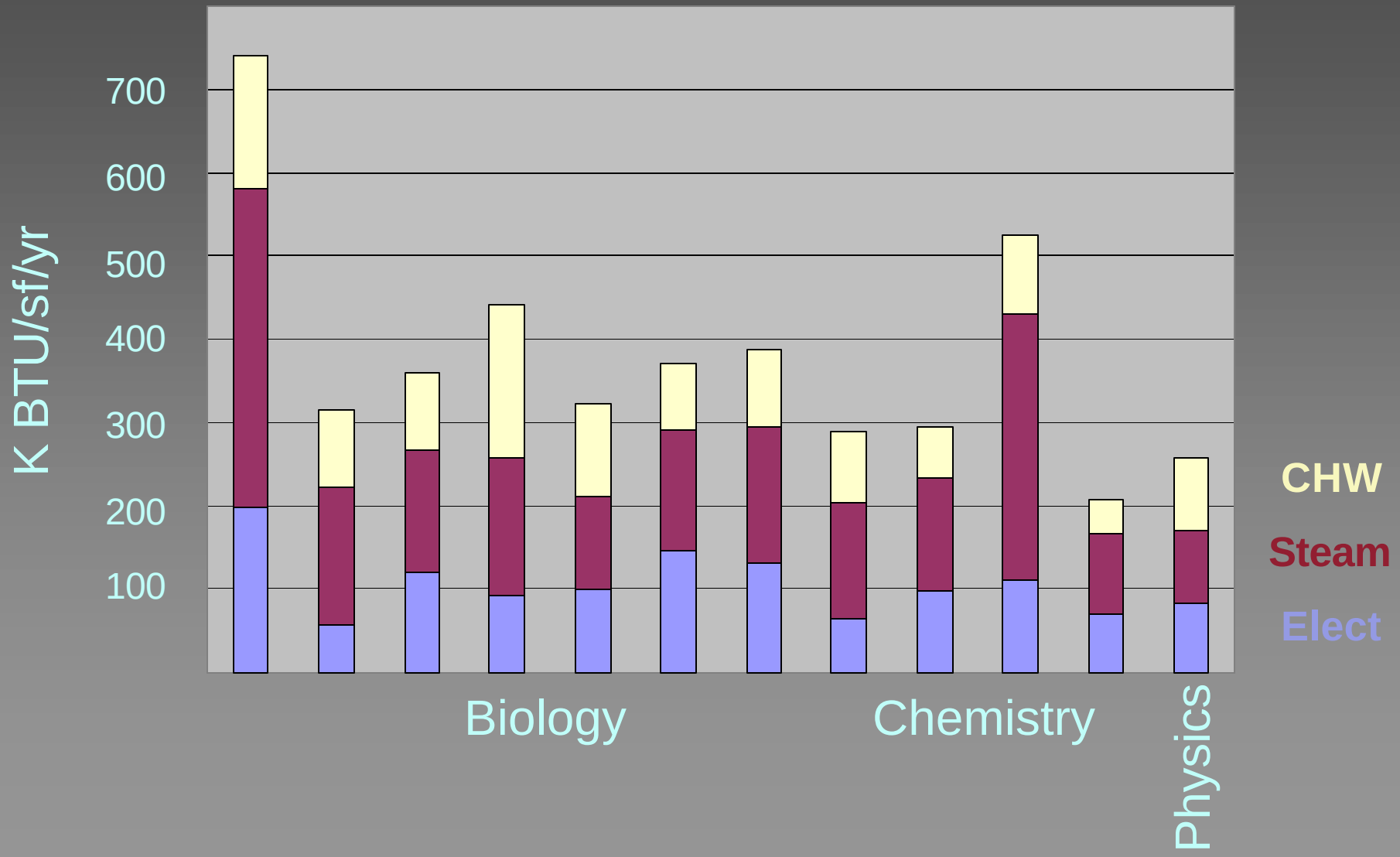
Ventilation Air Flow by Discipline



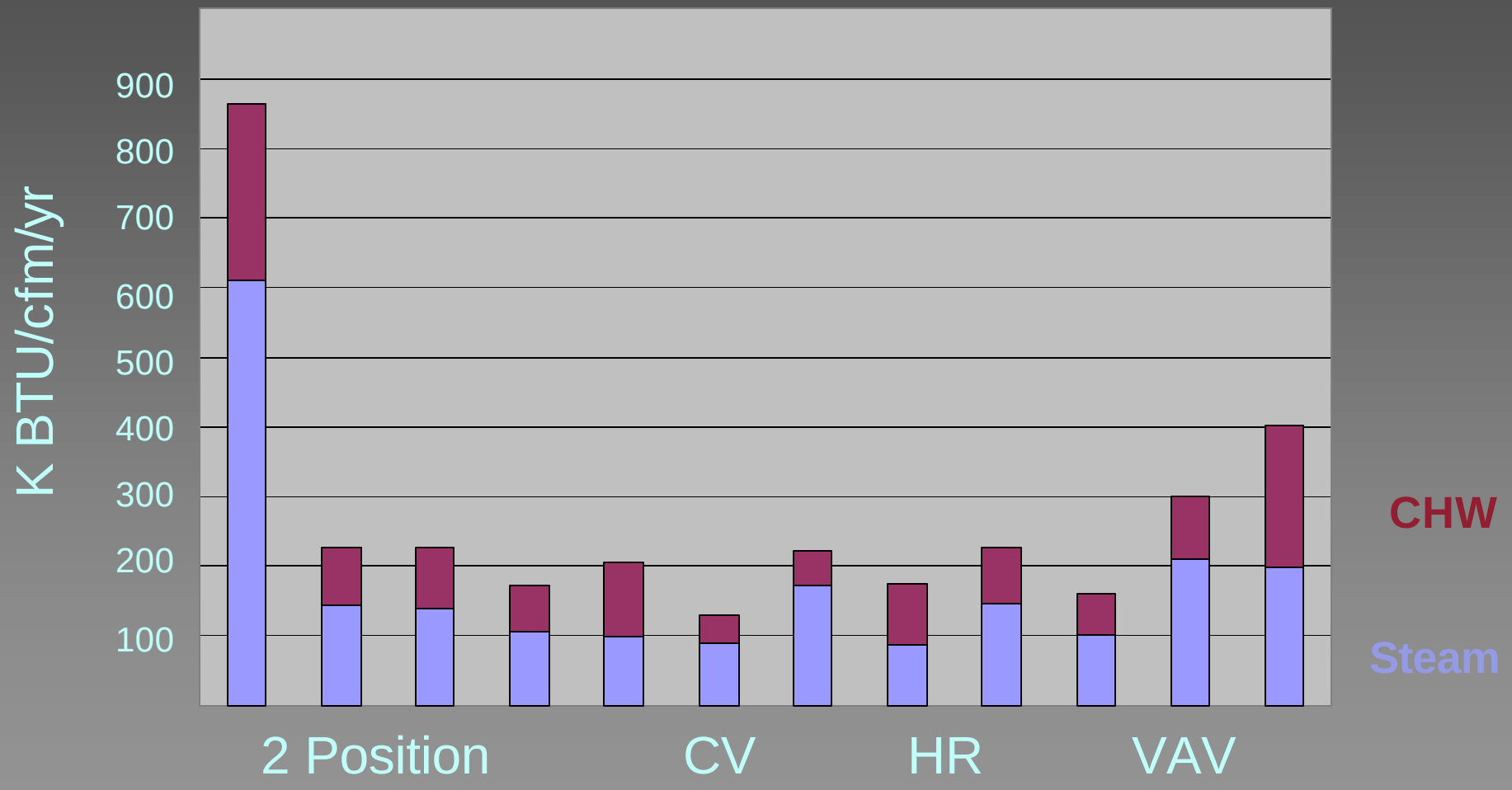
Total Energy Use by System Type



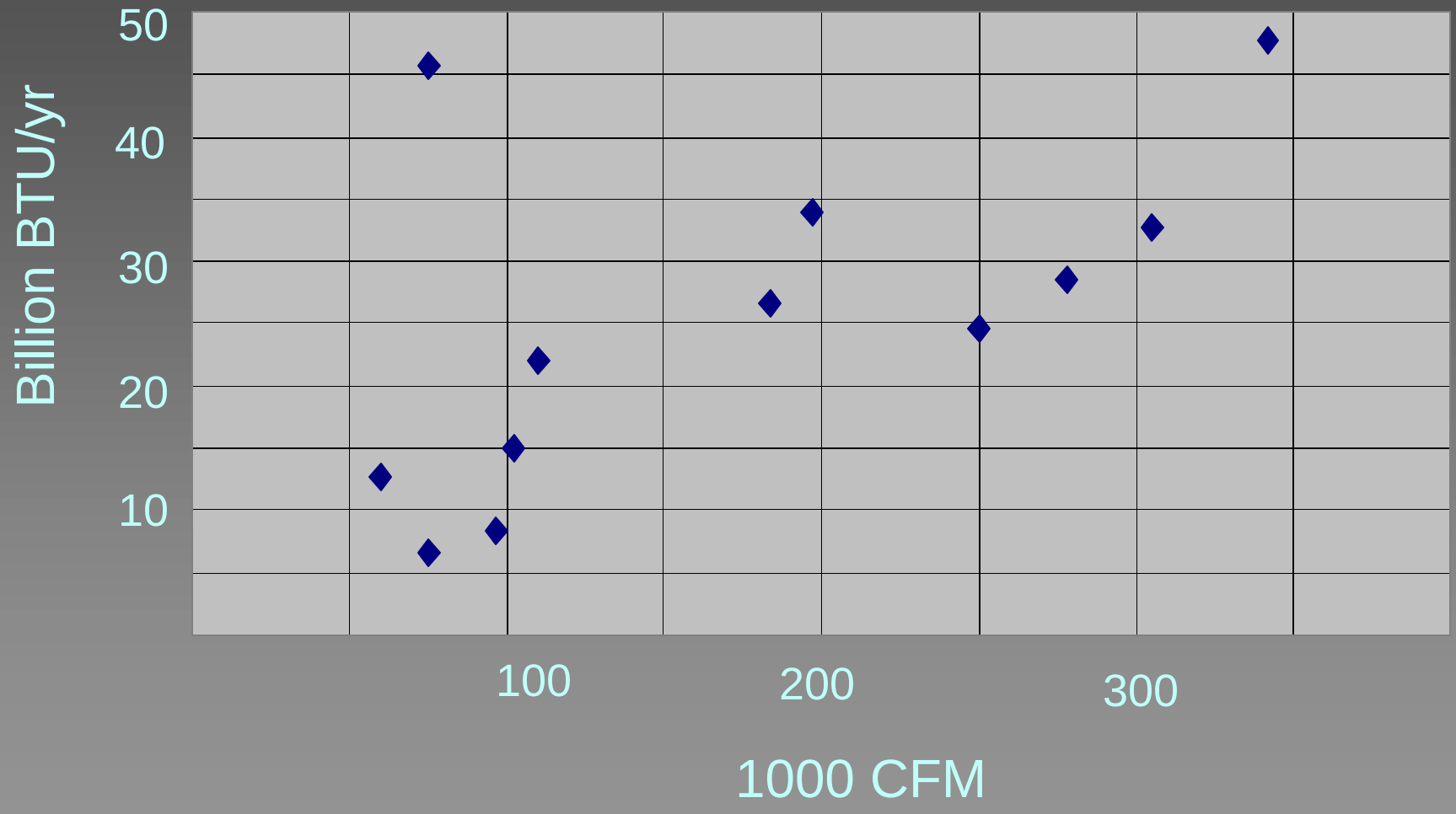
Total Energy Use by Discipline



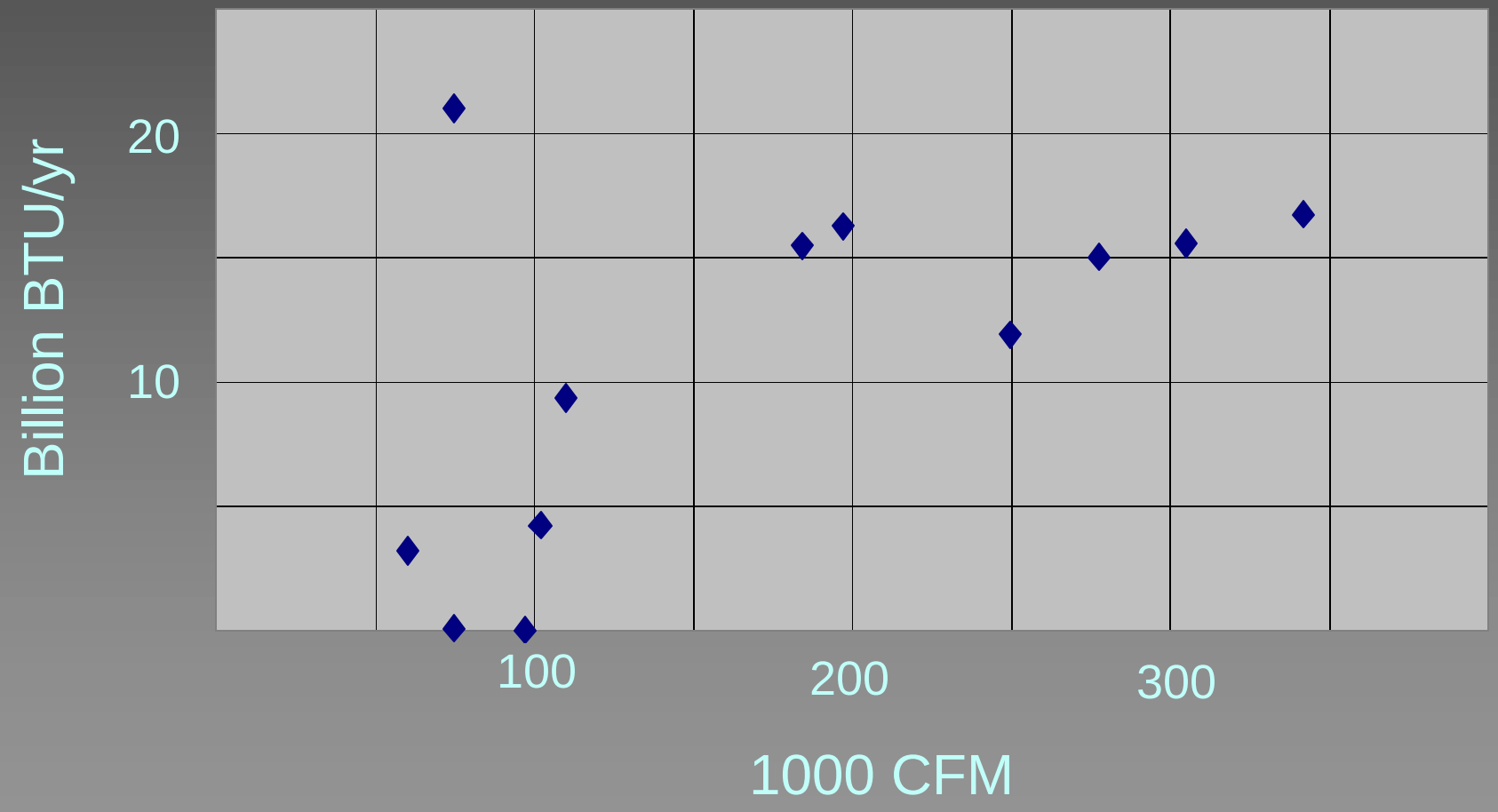
Energy Use Per CFM



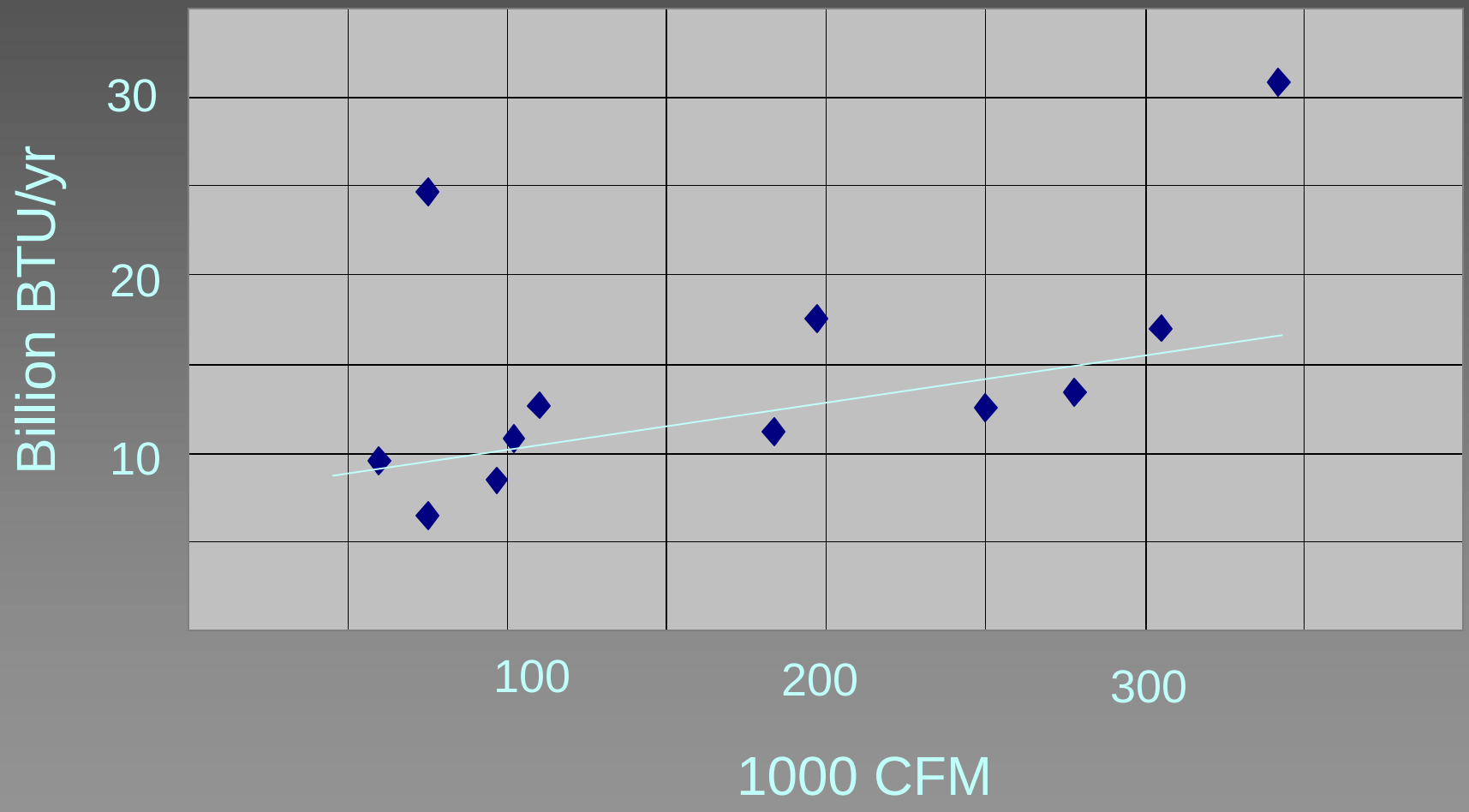
Steam Use vs. Peak Airflow



Base Steam Use vs. Peak Airflow



Variable Steam Use vs. Peak Airflow



Conclusions

- Extremely large variation in energy use suggests some buildings have considerable room for improvement
- The building sample was too small
- Labs with energy conservation systems did not show clear savings
- Metrics show promise for identifying severe operational/control problems
- Analysis of base and variable energy use shows promise for building energy analysis
- A larger database is needed but data will need climate adjustment

What Next??????

- More data is needed to identify patterns
- Use of data across country may be difficult as weather adds additional variable
- Test the use of building models against actual